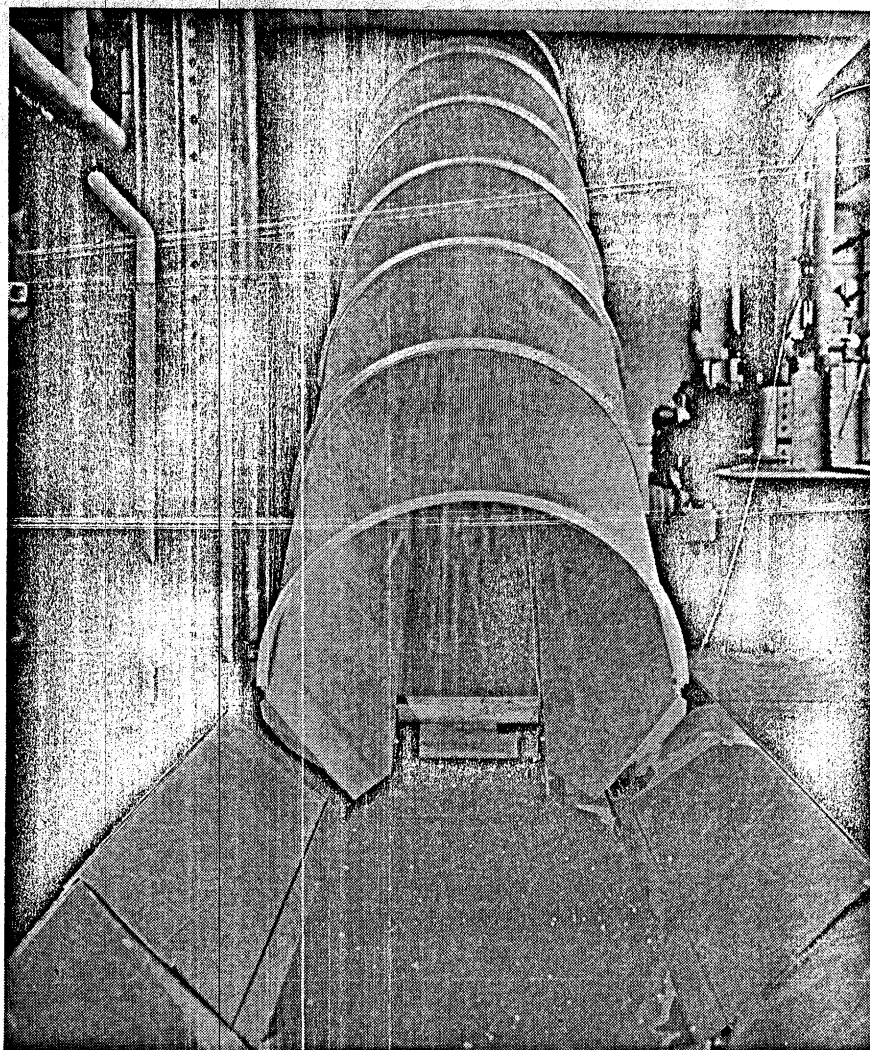


# DESIGN FASTER PUFFING GUN FOR DRYING



*WHITE STREAKS in chute are  $\frac{1}{8}$  inch potato dice that have just been fired from gun. Camera did not stop movement of pieces which left gun at high velocity but some pieces are visible in collector below chute*

**USDA demonstrates how to make practical for large scale operation the method of obtaining porous-structured products without vacuum . . . Porous structure being obtained by a puffing operation before final stage of drying**

**R. K. ESKEW, Chief**

Engineering and Development Laboratory  
Eastern Utilization Research  
and Development Division  
United States Department of Agriculture

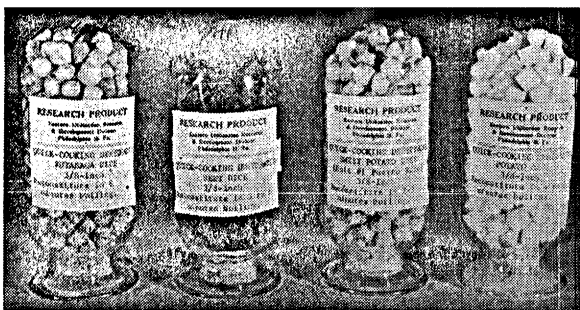
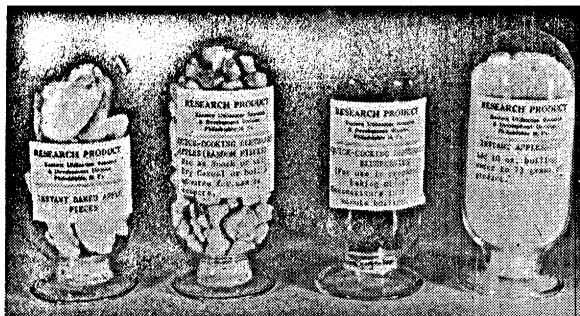
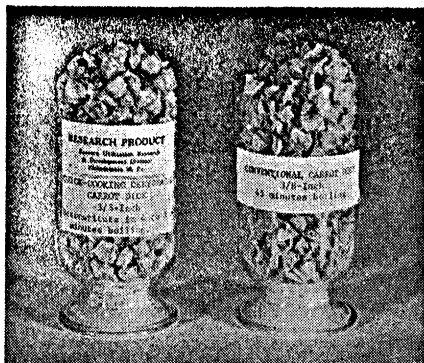
**PAUL GELBER**

Associate Editor

One commercial dehydrator is already in production of superior vegetables having a porous structure (see FP May 1964, p 125). Although the details of this operation have not been revealed, it is based on the method which USDA's Laboratory at Philadelphia developed and carried through the pilot plant stage (see simplified flow diagram).

Now, this laboratory shows how the capacity of the puffing gun, the most critical piece of operating equipment in the process, can be doubled.

Products made by this process are superior to conventionally dried for three reasons: exposure times to the hot air in tray, belt or bin dryers have been reduced by one third to one half, thus making for a higher quality product. Secondly, the porous structure facilitates rehydration (6 to 10 times faster) when the product is reconstituted by the housewife. Finally, the process permits making large, quick-cooking pieces that would not be feasible by conventional hot air drying.



**EXPLOSION PUFFED PRODUCTS** produced in USDA's pilot plant are white potato slices and dice, sweet potato dice, carrot dice, beet dice, rutabaga dice, blueberries, and slices and random pieces of apple. Lower photo shows a new product, instant apple-sauce, which is comminuted explosion puffed dehydrated apple pieces

**Two design innovations** described below have been incorporated in the new gun now being used by EURDD.

Here is how the EURDD process works on a pilot plant scale (see flow diagram). Twenty-pound charge of vegetables — sliced, diced or random pieces — dried to about 22 per cent moisture content in conventional dryer is loaded into puffing gun (see photo). Gun, which is really a form of a pressure cooker, is sealed, set in a horizontal position, and gun is rotated about its horizontal axis while it is heated externally by two gas burners.

Purpose of heating is to raise temperature of entrapped moisture in the vegetable pieces to well above atmospheric boiling point. With the former gun, two gas burners were the only source of heat.

Injection of superheated (see drawing) steam and a finned inner heat transfer surface — account for a more than three-fold increase in heat transfer rate (and a corresponding increase in capacity) in the new puffing gun.

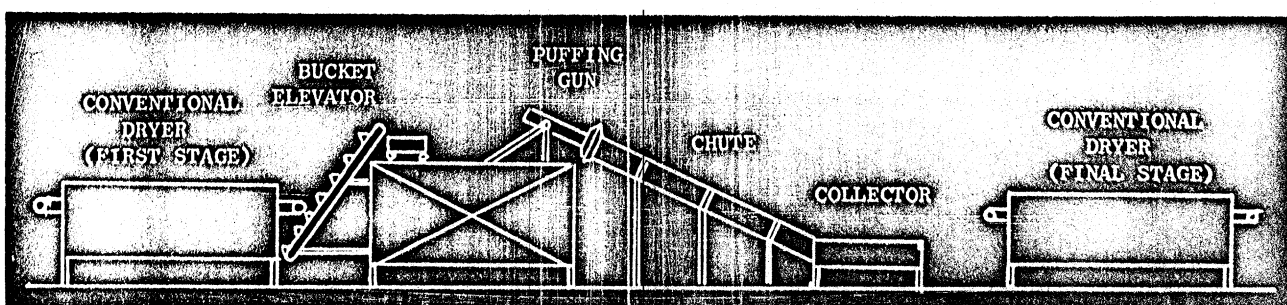
Thus, desired internal pressure of about 55 psig (depending upon product) is reached in under 4 minutes, one-third the time required with the former gun. At this time, gas and steam are turned off, gun is set in firing position (see photo) and the door is opened instantly.

Product is literally fired from gun through chute and into collector (see photo). At the instant of explosion, moisture in the interior of the vegetable pieces flashes off, and minute channels are formed as the water vapor escapes to atmosphere.

The now porous interior of the vegetable piece offers avenues of escape to the remaining moisture when the product is returned to the conventional dryer for final dehydration. Potato slices,  $\frac{3}{8}$ -in. potato dice and larger pieces which reconstitute in 4 to 6 minutes have been successfully

continued on page 87

**FLOW DIAGRAM** shows how puffing gun fits into vegetable drying operation. Amount of moisture removed in first drying stage depends on product. For white potato dice, about 75 per cent of moisture is removed during first stage; 6% during explosion puffing. Product leaves final drying stage at about 5 per cent moisture content



explosion puffed in EURDD's pilot plant. Other products (see photos) include sweet potato dice, carrot dice, beet dice, rutabaga dice, blueberries, and random pieces and slices of apples.

**New way to make applesauce** has been developed by USDA using explosion puffing process. Apple pieces, explosion puffed and dehydrated are coarsely ground to pass a

Drawings of new explosion puffing gun and additional information on process can be obtained by writing Eastern Utilization Research and Development Division, Agricultural Research Service, United States Department of Agriculture, 600 East Mermaid Lane, Philadelphia, Pennsylvania 19118  
5362 on Reader Service Slip.

20-mesh screen. When 2.5 oz of grind plus an appropriate amount of sugar are reconstituted with 10 fluid oz boiling water, a highly palatable instant applesauce results which has the same mouthfeel as applesauce made by conventional methods. **END**

Easy-to-read book  
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## Basic engineering principles for food processors

From "a"-utomation to "z"-eolite vater treatment is included in what can be described as the "best book in its field today" for modern dairy and food processors. The book, titled *Engineering for Dairy and Food Products*, not only covers most processing, handling and packaging operations, it describes each of the operations in a most comprehensive, easy-to-read, manner.

It is authored by Dr. Arthur W. Irrall who is presently chairman of the Department of Agricultural Engineering, Michigan State University. In his broad experiences, Dr. Irrall served as Director of Research for CP Division of St. Regis Paper Co.

This book of 674 pages is divided

into 22 chapters, which should be individually mentioned in order to convey the comprehensiveness of the subjects covered.

These chapters are: 1) Physical and Chemical Properties of Milk and Other Products; 2) Simple Mechanical Principles, including explanations of energy and centrifugal force; 3) Power Transmission; 4) Electrical Power and Equipment; 5) Hydraulics and Pumping; 6) Heat Measurement, Transfer and Control; 7) Steam and Its Uses; 8) Principles of Refrigeration; 9) Insulation and Cold Storage Rooms; 10) Heaters-Coolers, Heat Exchange Equipment; 11) Ice Cream Freezing Equipment; 12) Homogenizers; 13) Pasteurizers; 14) Evaporators and Dryers; 15) Can Washing and Sterilizing Equipment; 16) Bottle Washers, Fillers and Cappers; 17) Cream and Butter Handling Equipment; 18) Cheese Plant Equipment; 19) Material Handling; 20) Automation; 21) Maintenance; and 22) Plant Design, Construction, Materials.

At the end of each chapter is a list of questions and answers. Bibliography listings at the end of each chapter enable readers to find more detailed descriptions of individual topics. The book is liberally sprinkled with 93 reference tables and 249 authoritative diagrams and photos.

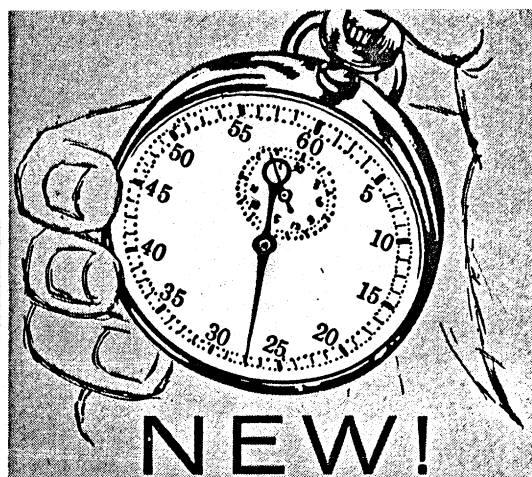
Although the book is mainly concerned with the dairy industry, the author explains that most of the basic principles of engineering for the dairy industry underlie the problems encountered in other branches of the food industry.

Well worth the price of \$17.00 per copy, the book is available from John Wiley & Sons, Inc., 605 Third Ave., New York 16, N.Y.

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With the increasing complexity in promotion, advertising and marketing, trademarks play a crucial role in sales. It is, therefore, essential to the companies who own and use trademarks to know their value and vulnerability. Such a guide is a 126-page, paperbound book titled *"Trademarks in the Marketplace."*

The book consists mainly of an



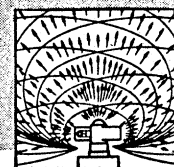
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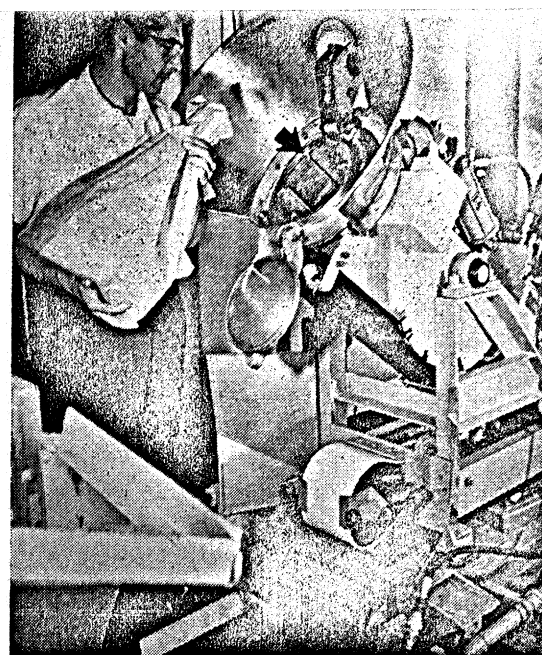
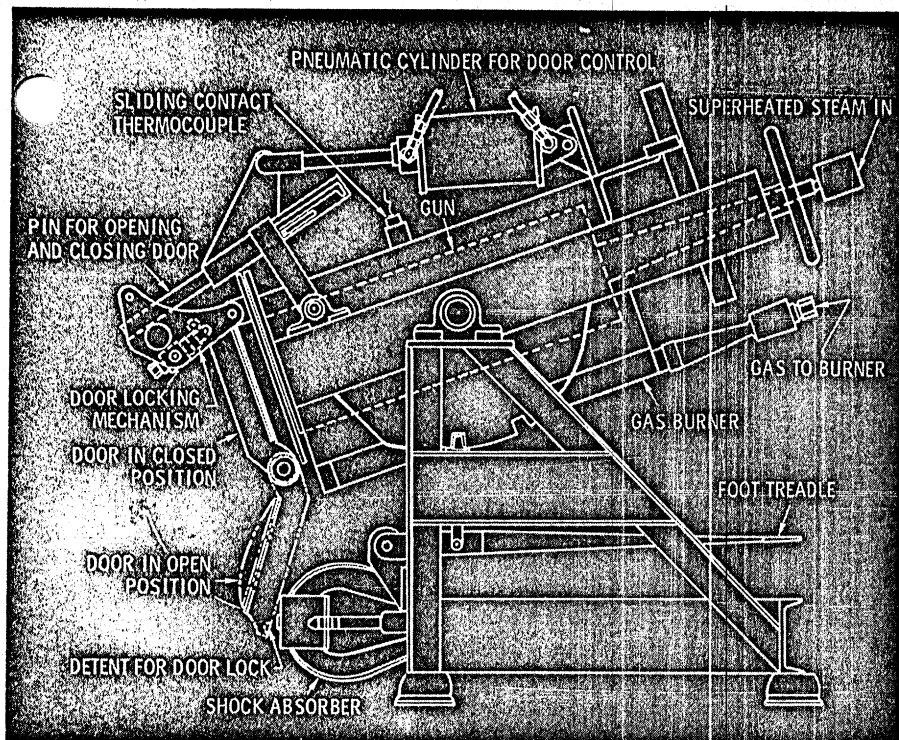
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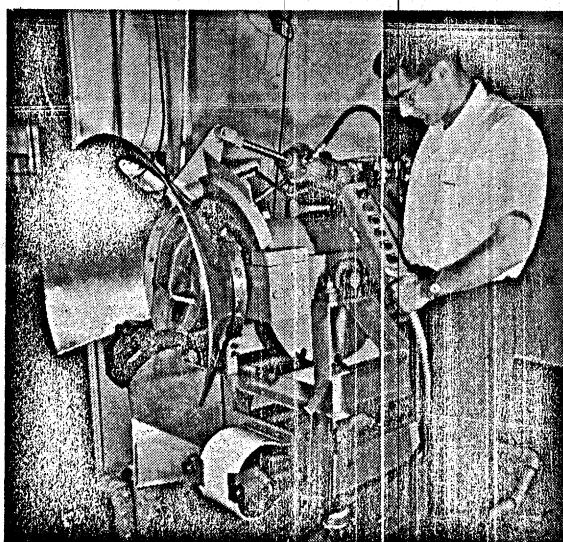


**DRAWING AND PHOTOS OF NEW PUFFING GUN.**

Important design innovation is injection of superheated steam directly into gun barrel to raise product temperature quickly. Longitudinal ribs (arrow in photo at left) integral with barrel inner wall supply added heat transfer surface during gas firing and further improve heat transfer by keeping the product in constant agitation during gun rotation.

Gun is balanced so that the selection of three different positions — loading, heating, firing — is easy. (Drawing shows gun in firing position). To position gun, operator depresses foot treadle which disengages position lockpin from detent. He then swings gun into desired position; removes foot from treadle, allowing lockpin to engage proper detent.

For firing, operator stops rotation of gun, engages lockpin in proper detent to position gun with respect to discharge chute. The pin for opening door is manually located and the pneumatic cylinder is actuated to pull pin out of detent in door. Internal pressure in gun blows door open instantly. Shock absorber cushions rapidly moving door.



**GUN READY TO BE FIRED by designer Wolfgang Heiland, Head of USDA's EURDD design section**

